

Missouri Target Industry Competency Model Information Technology



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Access to skilled workers is one of the foremost criteria that companies and site selectors consider when locating and expanding business in Missouri. The ability to show companies an available and sustainable pipeline of skilled workers continues to be the difference in Missouri's ability to turn economic development assets into family supporting job opportunities. To support these efforts the research arm of the Department of Economic Development, the Missouri Economic Research and Information Center (MERIC), has embarked on a project to bring together the appropriate state and local individuals to align education and workforce programs with the future talent development needs of companies.

Industry clusters defined as groups of interdependent businesses linked by core products or services as well as the potential for common supply chains, labor needs, technologies, and markets were identified. These are:

- Agribusiness
- Automotive
- Defense & Homeland Security
- Energy
- Finance
- Information Technology
- Life Sciences
- Transportation/Logistics

For each of these industry clusters Target Industry Competency Models would be developed with the help of target employers and education/training providers in the state.

The Target Industry Competency Model project is intended to identify personal effectiveness, academic, and occupation specific competencies for targeted businesses within the state's Information Technology (IT) industry cluster. In the first part of this report, it is revealed that along with technical skills employers view "soft skills" as crucial to work readiness. It is also determined that these skills are fundamental to every employee's ability to perform their job effectively. Further, technical competencies for major functions in the IT industry are listed. For the sectors of **Healthcare services**, **Financial Services** and **Homeland Security** sector specific technical competencies are developed. Finally, specialized training/education programs for the most common IT occupations in the industry are also identified in this report. These results are aimed to serve as a useful human resource tool within organizations and to help shape policies that will address the skill and curriculum gaps in order to meet the future needs of Missouri businesses.

The globalized marketplace along with the rapid development of technology has created a work environment where information and technology are the key ingredients for success in business. To reduce the gap between knowledge and ability there is a need for workers to have a better understanding of the skill sets needed for a job. By hiring properly trained individuals organizations save money and spend less time preparing their staff in their work roles while colleges and universities have a better understanding towards curriculum development and maintenance ¹.

The objective of designing a Competency Model is to develop a dynamic, industry-driven framework necessary for workers that will help them meet the demands of the globally competitive economy. This is particularly useful in a rapidly changing field such as Information Technology (IT) where accurate knowledge of the current and future skill requirement can enable timely direction of resources, development and revision of industry-relevant curriculum and efficient development of career information and job profiles².

Although IT is an important industry vertical segment (group of similar businesses and customers engaged in the same trade); this report investigates occupations relevant to IT viewed as a horizontal segment (group that meets the needs of a wide variety of industries). It is important to note that the competencies identified through this report can be customized for all industry verticals.

Some interesting Missouri IT facts:

- Between 2006-2016, it is expected that there will be a total of 25,332 job openings in the IT field within the state³
- Two of the five occupations with the most vacancies requiring a four-year college degree were Computer Software and Computer System Analysts⁴
- Computer Software Engineers, Applications and Network and Data Communications Analysts are among the top 20 fastest growing occupations in the state⁵
- From 2005 to 2025, Missouri's older population groups are projected to increase in size relative to the state's population as a whole⁶
- 60% of Missouri's workforce in 2025 is already working today⁶
- IT occupations account for almost 5.36% of the state's overall job openings³
- The average salaries for IT occupations in the state is \$63,404 with \$42, 547 for entry level and \$73,831 for experienced workers³

What is a Competency Model?

A competency is a specific, identifiable, definable and measurable skill or characteristic that is essential for the performance of an activity within a specific business or industry context. Some examples of competencies are safety awareness, critical analytical thinking, problem solving, communication, team work etc.

The first competency model was developed in the early 1970s for the US Department of State by David McClelland and his colleagues of McBer and Company as an alternative selection tool for junior Foreign Service Information Officers. Later McBer and Company developed a methodology that is still highly useful today in competency model building and comprises of *“focus on outstanding performers, use of behavioral event interviews, and thematic analysis of interview data and distillation of the results into a smaller set of competencies described in behaviorally specific terms”*. In the last 30 years this technique has gained importance as an integral practice in human resource management⁷.

Based on the US Department of Labor’s (DOL) framework, the competency model can be described as a pyramid consisting of a hierarchical set of tiers. The pyramid is divided into 3 main blocks of **Foundational competencies**, **Industry Related** and **Occupation Related competencies**. Each of these blocks is made up of tiers which consist of a set of competencies that represent the skills, knowledge and abilities essential to be successful in an occupation in the industry the model represents.



Source: www.CareerOneStop.org/CompetencyModel

Starting from the base, the tiers cover competencies that are common to several occupations and industries. As we traverse up the pyramid, the competencies become industry and occupation specific. It is important to note that the above picture does not suggest that this is a sequential model i.e. one needs to have all the below competencies in order to possess / develop the higher level competencies. The model is constructed in a bottom-up approach using a combination of research, data collection and analysis, focus groups and case study interviews.

Uses of Competency Models

Competency Models benefit a wide array of users – as a standard set of skills that can be used for recruiting, profiling jobs, evaluating employees, designing academic and professional certification programs. They serve as a bridge between educators, businesses and other stakeholders who are invested in preparing students and workers for today's workplace challenges.

Competency Models can be used by employers as a **useful selection and professional development tool**. It can assist HR staff match specific skills and work requirements to different jobs at selection, promotion, career path development and while developing training programs for the organization. It can help to assess performance of individuals in their jobs as well as in their roles of managers, direct reports, customers and team members. It can also be a means for businesses to communicate their performance expectations to their workers.

Competency Models can serve as a **measure of the gap between employer needs and the offerings of the current education and training delivery system**. Contents of existing coursework can be reviewed and mapped against the tier competencies and a crosswalk can be created and “gaps” can be identified. As education/ training providers evaluate existing programs or design new ones, the Competency model can **serve as a benchmark**, resulting in addition of courses that will match workplace requirements and trends².

Training providers can also use competency models to **develop industry-validated certifications**. Acquiring such a certification establishes that the graduate of the particular training program has demonstrated mastery in the competencies as stated in model for that industry or sector⁸.

Competency models work as a guide for Workforce Investment Boards and One Stop Career Centers to **match job requirements and skill sets determined by employers to potential candidates**. In this way an even larger group of individuals such as in-school youth, out-of school youth, dislocated workers, current workers, and special needs populations are serviced thus increasing the talent pool of available workers.

As these key partners work together by sharing assets and resources, the competency model provides a **good guidance for government investments in workforce preparation strategies** within a region or the state.

Best Practices

A great deal of research has been done to design competency models by both the private sector and government agencies to address the skill needs of these entities.

McMurtrey et al conducted a study that investigated the most critical skills for IT professionals. They created taxonomy of skills that were divided into four areas: Core Knowledge, Technical Proficiency, Business Expertise and Personal Attributes. The conclusion of their study was that both technical and non-technical skills were important for success in this profession particularly in entry-level jobs¹.

The Illinois Occupation Skill Standards guides workforce preparation programs and employers to establish the skills and standards necessary for a job in the IT cluster. The components of the skill standard are: Performance Area, Performance Skill, Skill Standard, Performance Elements and Performance Assessment Criteria. The intent of this program is to promote education and training investment as well as to ensure the supply of a trained workforce⁹.

The Nevada Department of Education in collaboration with local academic institutions and businesses developed the Information Technology skill standards. The report identified seven career clusters within the IT field and defined eleven essential core IT skills essential to the job. The purpose of this report is to prepare current students to attain the skills needed to meet the future demands of the IT industry through secondary and post secondary (9-14) IT programs¹⁰.

In Georgia the competency-based curriculum framework for IT outlines core employability skills for IT occupation in collaboration with businesses and educators. The main objective of this initiative is to ensure that curriculum reflects the demands of the workplace and is well positioned to prepare students to meet these needs for success in their future jobs¹¹.

The *itWORKS.OHIO* report is the career field technical content standards documents for information technology. It serves as the curriculum framework for Ohio College Tech Prep and Career-Technical Educational programs in IT. Used in collaboration with other programs in the state, this document forms the basis for enhancing and expanding career-technical education and post secondary degree programs in IT¹².

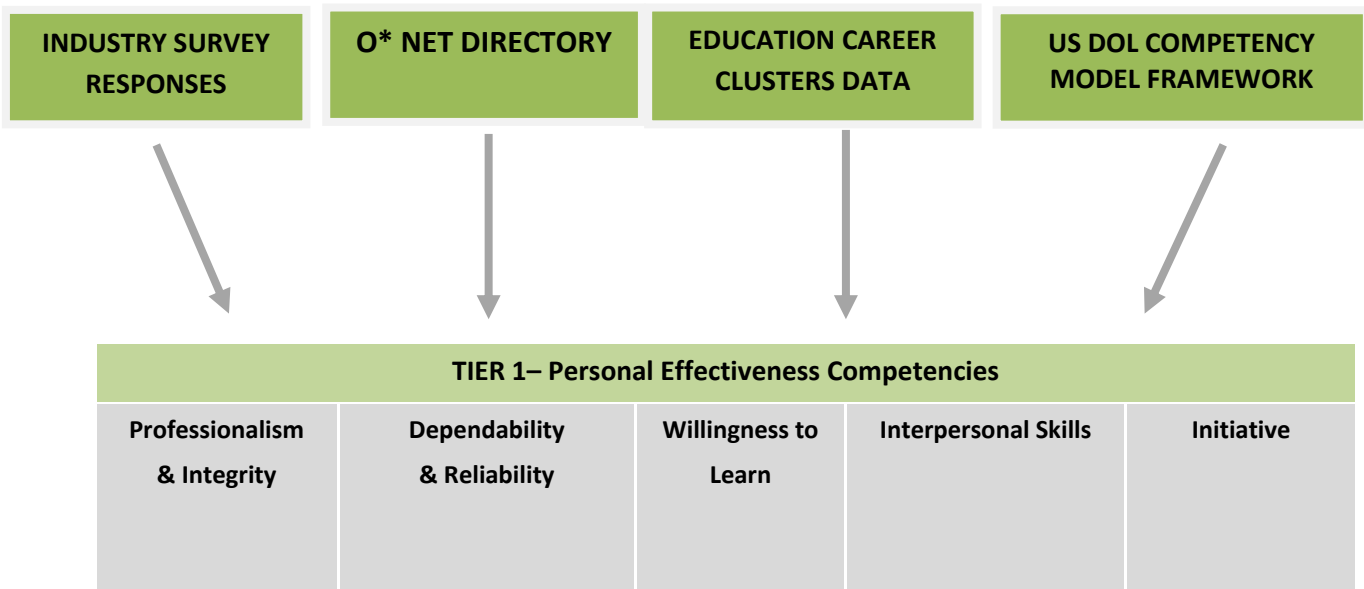
Sponsored by the National Science Foundation, the National Workforce Center for Emerging Technologies developed a skill standard report for Information Technology jobs in 1999 and later updated it in 2003. Skill standards were developed for eight main career clusters within IT that represented a broad range of jobs. This report was targeted to be of use to educators, human resource professionals, training certification and assessment developers, students and job seekers as well as workforce researchers².



The **Foundational Competencies** block includes Tiers 1 through 3 and the essentials for early success in school and work life are identified. These competencies are integral for all workers to be successful in any organization and across all occupations in all industries. An industry survey with a specific set of questions was designed and administered to IT industry professionals in the region to identify the competencies in this tier. Often business leaders elaborated on certain competencies outside the survey questions, which was also incorporated into the tiers.

Tier 1: Personal Effectiveness Competencies

Starting at the bottom of the pyramid this tier is comprised of competencies that are often referred to as “soft skills” and essential in all life roles. Using the US-DOL competency model as a framework, the survey results were mapped against O*Net(a system that serves as the nation's primary source of occupational information, providing comprehensive information on key attributes and characteristics of workers and occupations) and Education Clusters data to develop this tier.



Each competency is then described in terms of behavioral attributes.

Professionalism & Integrity

Attributes
Demonstrates self discipline, self-worth and positive attitude in a work situation
Is free from substance abuse
Maintains a professional appearance
Complies with organizational policies and procedures
Takes responsibility for one's own work assignment

Dependability & Reliability

Attributes
Follows policies and procedures, thus exhibiting commitment to the organization
Diligently follows through on commitments and consistently meets deadlines
Demonstrates regular and punctual attendance

Willingness to Learn

Attributes
Is flexible and willing to learn new knowledge and skills
Develops a personal career plan to meet career goals and objectives
Demonstrates knowledge of IT as a constantly changing and fast growing field
Takes charge of personal career development by identifying occupations interests, strengths, options and opportunities

Interpersonal Skills

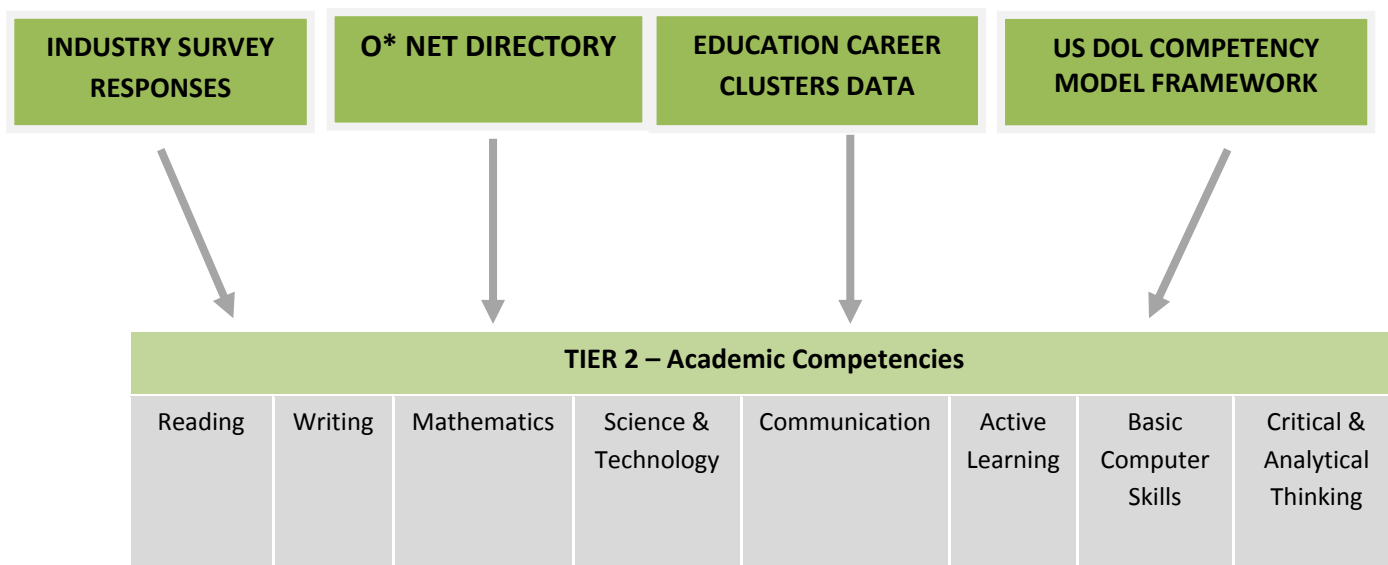
Attributes
Maintains open communication with others, recognizes and accurately interprets the verbal and non verbal behavior of others.
Demonstrates culture and diversity awareness
Displays adequate concern for others by being sensitive to their needs and feelings

Initiative

Attributes
Pursues work with energy, drive and goes beyond routine demands of the job
Strives to exceed standards and expectations
Establishes and maintains personally challenging but realistic work goals
Is able to perform effectively even with minimal direction and support
Self motivated

Tier 2—Academic Competencies

The second tier in the Foundation competencies block covers basic educational competencies that are learned in an educational setting along with cognitive functions and thinking styles. Typically these competencies form the foundation for the Occupation and Industry specific Competencies. This tier was also developed by mapping the survey results against O*Net and Education Clusters data.



Each competency is then described in terms of behavioral attributes.

Reading

Attributes
Comprehends and evaluates oral and written information in documents
Locates written information from various sources to communicate with co-workers and clients or participants
Demonstrates ability to use reading strategies to learn meaning, technical concepts, vocabulary and follow instructions
Identifies main ideas, notes details and facts, detects inconsistencies, identifies implied meaning, missing information and trends

Writing

Attributes
Demonstrates ability to organize/collect, evaluate and present written information
Uses correct grammar, punctuation and terminology to write and edit documents
Interprets and uses tables, charts, figures to support written and oral communication
Adapts language for audience, purpose, situation

Mathematics

Attributes
Demonstrates mathematics knowledge and skills required to pursue opportunities within the IT cluster
Applies, translates problems into appropriate math calculations

Science & Technology

Attributes
Demonstrates Science knowledge and skills required to pursue a career cluster within the IT cluster
Applies basic principles and technology to complete tasks

Communication

Attributes
Interprets verbal and non verbal behaviors to enhance communication with co-workers and clients / participants
Applies active listening skills to obtain and clarify information
Demonstrates ability to communicate and resolve conflicts with a diverse group
Influences or persuasively presents thoughts and ideas, gains commitment and ensures supports for proposed ideas

Active Learning

Attributes
Applies a range of learning techniques to acquire new knowledge and skills, processes and retains information; identifies when it is necessary to acquire new knowledge and skills
Integrates new knowledge to complete tasks

Basic Computer Skills

Attributes
Understands basic computer hardware and software to perform tasks and is familiar with fundamental capabilities of computers
Accesses and evaluate Internet resources
Uses word processing programs to create, edit and retrieve files
Uses electronic mail applications

Critical and Analytical Thinking

Attributes
Demonstrates sufficient inductive and deductive reasoning ability to perform job
Identifies connections between issues, quickly understands, orients and changes direction when working on multiple projects or issues
Simple solutions to problems, common sense

Tier 3 —Workplace Competencies

The competencies in this tier include those skills and abilities that permit an individual to conduct his/her work related activities in an effective and efficient manner. These competencies were derived from the Education Career Cluster Data and the US DOL Competency Model Framework.



TIER 3 – Workplace Competencies						
Teamwork	Adaptability/ Flexibility	Customer Focus	Planning & Organizing	Problem Solving & Decision Making	Business Fundamentals	Working with Tools & Technology

Each competency is then described in terms of behavioral attributes.

Teamwork

Attributes
Builds interpersonal skills with individuals and other team members
Understands best practices for successful team functioning
Gives and receives feedback constructively
Leverages the strengths of others to accomplish a common goal

Adaptability / Flexibility

Attributes
Is able to adapt and manage change and entertains new ideas
Demonstrates ability to work with people from diverse backgrounds
Performs more than one task at a time while being able to follow each task through to completion



Customer Focus

Attributes
Demonstrates knowledge of organization's offerings and of customers' importance to the organization
Demonstrates ability to assist customers in a professional manner

Planning & Organizing

Attributes
Plans and prioritizes work to manage time effectively and accomplish the assigned tasks
Develops plan, timeline, list of resources required, goals for projects and adheres to them
Finds ways to organize work to accomplish tasks more efficiently

Problem Solving and Decision Making

Attributes
Identifies or recognizes the existence of a problem and analyzes the components of it
Generates a variety of solutions to the problem

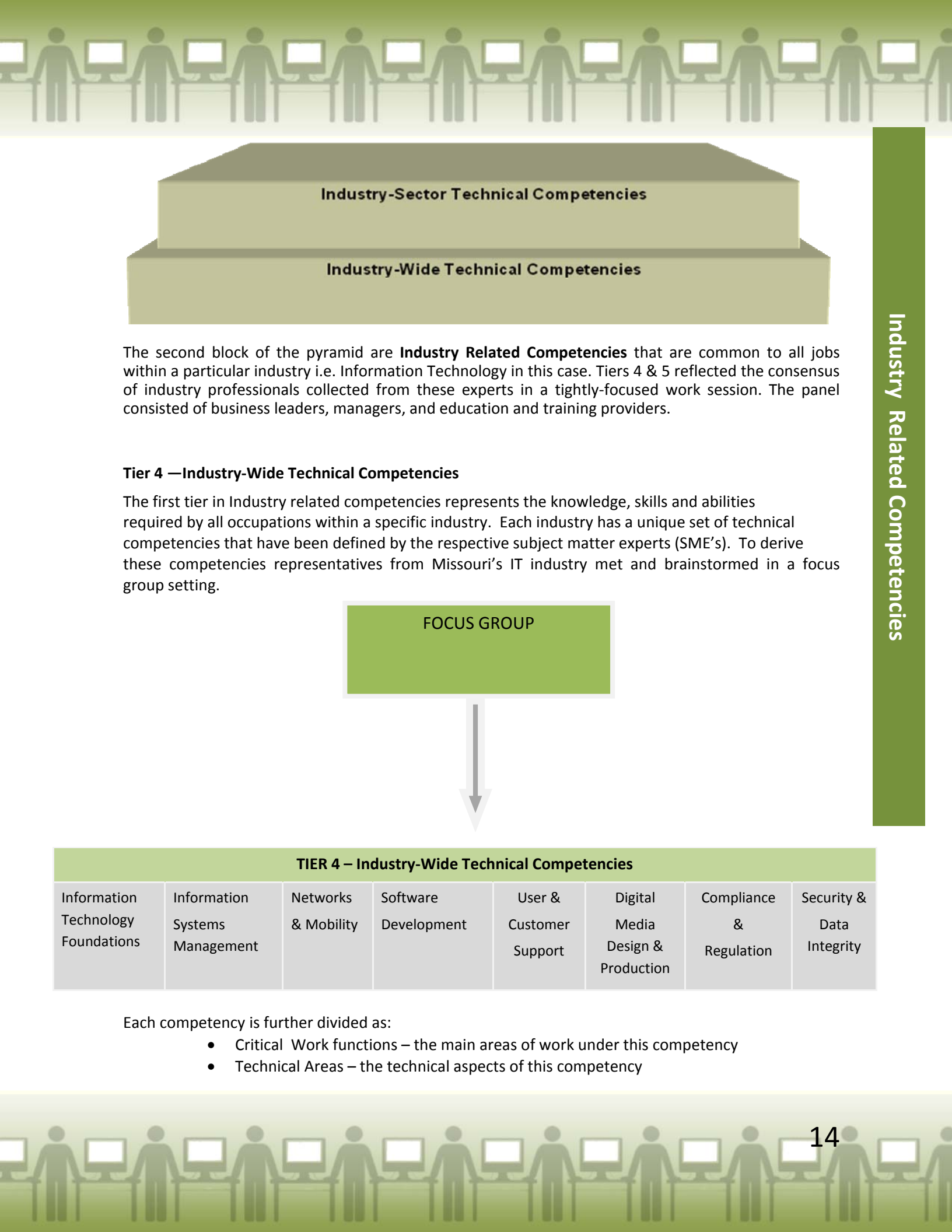
Business Fundamentals

Attributes
Identify industry trends and understand the company's position in the market as well as in comparison to competition

Working with Tools and Technology

Attributes
Knowledge of Microsoft Office Products and skills

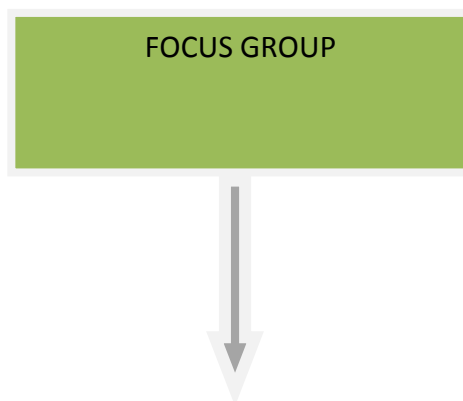




The second block of the pyramid are **Industry Related Competencies** that are common to all jobs within a particular industry i.e. Information Technology in this case. Tiers 4 & 5 reflected the consensus of industry professionals collected from these experts in a tightly-focused work session. The panel consisted of business leaders, managers, and education and training providers.

Tier 4 —Industry-Wide Technical Competencies

The first tier in Industry related competencies represents the knowledge, skills and abilities required by all occupations within a specific industry. Each industry has a unique set of technical competencies that have been defined by the respective subject matter experts (SME's). To derive these competencies representatives from Missouri's IT industry met and brainstormed in a focus group setting.



TIER 4 – Industry-Wide Technical Competencies							
Information Technology Foundations	Information Systems Management	Networks & Mobility	Software Development	User & Customer Support	Digital Media Design & Production	Compliance & Regulation	Security & Data Integrity

Each competency is further divided as:

- Critical Work functions – the main areas of work under this competency
- Technical Areas – the technical aspects of this competency



Information Technology Foundations

Critical Work Functions:

- Information Management
- IT Financial Management
- Networking
- Software Development
- Systems Development Life Cycle
- User and Customer Support
- Visual Communications
- Web Systems and Technology

Technical Areas :

Business Process Management

- Business activity management
- Business process management
- Change management
- Content management
- Document management
- Imaging
- Process Improvement and Process modeling
- Systems process integration

IT Organizational Structure

- IT integration within a company
- Support for business solutions

Platform Technologies

- Architecture and organization
- Computing infrastructures
- Enterprise deployment software
- Firmware
- Hardware
- Open source

Systems Administration and Maintenance

- Administrative activities
- Administrative domains
- Applications

Systems Integration and Architecture

- Acquisition and sourcing
- Architecture
- Integration and deployment
- Organizational context
- Requirements
- Testing and quality assurance

Web Management

- Analytics



- Key performance indicators
- Optimization
- Utilization

Information Systems Management

Critical Work Functions:

- Analyze and Design Databases
- Business Intelligence
- Content Management
- Develop and Implement Databases
- Maintain Quality Assurance
- Perform Database Administration and Maintenance
- Perform Database Testing
- Performance Analytics
- Provide Data Assurance

Networks & Mobility

Critical Work Functions

- Design Local area, Wide Area and Virtual Networks
- Install and Expand New facilities
- Optimize and Maintain Network Software and Hardware
- Manage, Administer and Secure Local Area Networks
- Perform Network Infrastructure Troubleshooting

Technical Content Areas:

- Application areas
- Foundations of networking
- LANS, WANS, virtual networks
- Mobile media
- Network management
- Physical layer
- Protocols (e.g. TCP, UDP, VoIP)
- Routing and switching
- Security
- Wireless

Software Development

Critical Work Functions:

- Analyze, Design, Develop, Adapt, Test and Maintain computer and Internet-based Applications
- Apply Principles of User-centered Design to Increase the Usability
- Establish and Maintain Consistency of a Product's Performance and its Functional and Physical Attributes with its Requirements, Design, and Operational Information Throughout its Life Cycle

- Implement, Support and Maintain Applications
- Test and Validate Applications

Technical Content Areas:

Application Architecture

- Configuration and adaptation
- Deployment
- Global standards
- Patterns
- Risk management
- Scalability
- Standards
- Strategies

Development/Programming Fundamentals

- Data structures (list, vector, array, stack, queue, tree, graph)
- Algorithms (sorting, searching)
- Basic programming constructs (assignment, arithmetic expressions, loops, conditions, input/output, error handling)
- Event-driven programming
- Object oriented programming
- Programming concurrent processes
- User interface/user experience (UIUX)

Development/Programming Technologies

- Data mapping and exchange
- Familiarity with multiple programming languages
- Integrative coding
- Inter-systems communications
- Parallel systems development/programming
- Scripting techniques
- Software security practices

Social Networking Services

- Business/educational/personal networks
- Internal/external services
- Privacy/security
- Social capital

Web Development

- Quality assurance
- Technical content
- Web site design
- Web site development/programming and maintenance
- Web site/Internet security

User & Customer Support

Critical Work Functions:

- Assess User Needs

- Deploy Hardware/Software
- Monitor Metrics and Performance
- Provide Customer Service and Support
- Provide Training on New Hardware/Software
- Troubleshoot Problems

Technical Content Areas:

Engagement

- Communicating with the user
- Community architecture
- Content development and categorization
- Engagement success metrics
- Gadgets
- Inventory and audit of content assets

Helpdesk Functions

- Administrative activities
- Application support
- Asset management
- Computing infrastructures and networks
- Configuration management
- Incident and problem management
- Operating systems
- Release management
- Systems administration, monitoring, and maintenance
- Strategies for engaging the community
- User participation guidelines/ground rules

Digital Media

Critical Work Functions:

- Design, Edit and Develop Audio, Video, Graphic and Animations
- Use Specialized Software Applications to Create Digital Media for Kiosks, Computer Applications, Websites, Print Media, Broadcast Media And Entertainment
- Visualize Graphic Representation of Concepts or Data

Technical Content Areas:

- Digital media application test and implementation
- Digital media design
- Digital media production and acquisition
- Gaming
- Graphics
- Multi-media technology
- Multi-user applications
- Streaming technologies
- Utilization and optimization

- Videos and dialogues
- Visual and functional design

Compliance

Critical Work Functions:

- Conduct Business Within the Standards of Corporate Ethics and Compliance
- Develop Measures to Ensure that Data and Information Systems Comply With Federal, State, Local Laws and Regulations, and Third Party Guidelines
- Develop Measures to Protect Confidential Data
- Follow Governance, Risk Management and Compliance Procedures

Technical Content Areas:

Compliance Standards

- Global and Internet standards

Important Topics

- Intellectual property
- Professional ethics
- Safeguarding confidential data

Public Policy

- Client program management operations (PMO)
- Code of Federal Regulations (CFR)
- ISO requirements
- State and local laws

Security & Data Integrity

Critical Work Functions:

- Assure data and information systems are available to authorized uses and ensures data integrity
- Protect data and information systems from accidental disclosure or destruction
- Protect data and information systems from unauthorized access or modification
- Protect data and information systems vulnerable to inappropriate use or malicious compromise

Technical Content Areas:

Data Accessibility

- Fundamentals of data security
- Operational issues
- Policy development
- User and customer support

Data Integrity

- Business continuity
- Disaster recovery
- Encryption
- ID management
- Information states



- Redundancy

Security Clearance

- US Citizenship (if required)

Threats

- Attacks
- Forensics
- Security domains
- Security mechanisms
- Security services
- Security tools
- Threat analysis model
- Vulnerabilities



Tier 5 —Industry-Specific Technical Competencies

This tier includes competencies that represent knowledge, skills and abilities required for all occupations within a specific industry sector. As mentioned earlier, this report employs IT as an industry horizontal and competencies for IT occupations across certain industries are investigated. Missouri staffing patterns reflected high IT employment in specific sectors such as **Healthcare Services**, **Financial Services** and **Homeland Security**. During the focus group sessions, industry representatives also vetted these as the three major sectors using IT in Missouri. Within each of these sectors, Knowledge Areas (KAs) were identified. These KA's provide a list of competencies that all workers in the specific industry must have to be effective in their occupations.

FOCUS GROUP

TIER 5 – Industry-Specific Technical Competencies

Healthcare Services	Financial Services	Homeland Security
Electronic Data Capture Medical Device Management Data Retention, Storage and Archiving Data Privacy and Security Litigation Response CMS – Medicaid / Medicare E-Discovery Clinical Information Systems – HTT, PHR HER Telemedicine Medical Imaging Web Portals	Banking Systems Electronic Funds Transfers Business Intelligence & Reporting Imaging and Document Management Information Security Regulatory Compliances e.g.: SOX, Standard Bodies & Agencies	Communication Surveillance Data warehousing Business Analysis Interagency operability Information Security



The last group consists of **Occupation related competencies** and is defined in terms of occupation related knowledge, education, credentials and performance. They are derived from the O*Net directory. A specific list of IT occupations has been focused on in these tiers. The 12 Targeted IT occupations were identified as follows: a custom industry staffing pattern was identified for the IT industry cluster in Missouri. These were sorted by their impact on the economy and then mapped against the US DOL’s In Demand occupation list for IT. This list was then vetted by the State’s industry specialists and is as described below:

O*NET-SOC Code	Title
11-3021	Computer and Information Systems Managers
15-1021	Computer Programmers
15-1031	Computer Software Engineers, Applications
15-1032	Computer Software Engineers, Systems Software
15-1041	Computer Support Specialists
15-1051	Computer Systems Analysts
15-1061	Database Administrators
15-1071	Network and Computer Systems Administrators
15-1081	Network Systems and Data Communications Analysts
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers
49-9052	Telecommunications Line Installers and Repairers

It is important to note that the occupations in this list are obtained from the state’s list of occupations in the IT cluster and do not include the entire gamut of IT occupations available.





Tier 6 —Occupation-Specific Knowledge Areas

This tier contains the specific **knowledge areas** that are required for the 12 targeted IT occupations. Each knowledge area covers an area of expertise that the respective occupation requires.

O* NET DIRECTORY



TIER 6 —Occupation Specific Knowledge Areas for :

Computer and Information Systems Managers

Computer Programmers

Computer Software Engineers, Applications

Computer Software Engineers, Systems Software

Computer Support Specialists

Computer Systems Analysts

Database Administrators

Network and Computer Systems Administrators

Network Systems and Data Communications Analysts

Sales Representatives, Wholesale and Manufacturing, Technical and
Scientific Products

Telecommunications Equipment Installers and Repairers, Except Line Installers

Telecommunications Line Installers and Repairers

Computer and Information System Managers

- Computers and Electronics
- Administration and Management
- Customer and Personal Service
- Production and Processing
- English Language
- Personnel and Human Resource
- Telecommunications
- Economics and Accounting

Computer Programmers

- Computers and Electronics
- English Language
- Mathematics

Computer Software Engineers, Applications

- Computers and Electronics
- Engineering and Technology
- Mathematics
- Telecommunications
- English Language
- Design

Computer Software Engineers, Systems Software

- Computers and Electronics
- Mathematics
- English Language
- Engineering and Technology
- Customer and Personal Service
- Design Education and Training
- Communication and Media
- Clerical
- Telecommunications

Computer Support Specialists

- Computers and Electronics
- Customer and Personal Service
- English Language
- Telecommunications
- Clerical
- Administration and Management
- Engineering and Technology

Computer Support Analysts

- Computer and Electronics
- English Language
- Customer and Personal Service
- Clerical
- Mathematics
- Education and Training

Database Administrator

- Computer and Electronics
- English Language
- Customer and Personal Service
- Mathematics
- Clerical

Network and Computer Systems Administrator

- Computer and Electronics
- English Language
- Mathematics
- Administration and Management

Network Systems and Data Communication Analysts

- Computers and Electronics
- Customers and Personal Service
- Telecommunications
- Administration and Management
- Education and Training
- English Language
- Engineering and Technology
- Mathematics

Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

- Sales and Marketing
- Customers and Personal Service
- English Language
- Computer and Electronics
- Production and Processing

Telecommunications Equipment Installers and Repairers, Including Line Installers *

- Telecommunications
- Computers and Electronics
- Customer and Personal Service
- Mechanical
- Public Safety and Security
- English Language
- Education and Training
- Engineering and Technology
- Mathematics
- Administration and Management

*Telecommunications Equipment Installers and Repairers, Except Line Installers and Telecommunications Line Installers and Repairers share the same **Knowledge Areas** hence they are combined.



Tier 7 —Occupation-Specific Technical Competencies

All occupations require certain technical competencies to perform the job. This tier contains **technical competencies** that are specific to the 12 targeted IT occupations. Listed below are the ones required for each technical competency.

O* NET DIRECTORY



TIER 7 —Occupation Specific Technical Competencies for:

Computer and Information Systems Managers

Computer Programmers

Computer Software Engineers, Applications

Computer Software Engineers, Systems Software

Computer Support Specialists

Computer Systems Analysts

Database Administrators

Network and Computer Systems Administrators

Network Systems and Data Communications Analysts

Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

Telecommunications Equipment Installers and Repairers, Except Line Installers

Telecommunications Line Installers and Repairers



Computer and Information System Managers

Tools used in this occupation	Technology used in this occupation
Access servers Computer Tool kits Network Analyzers Network interface cards Peripheral controller cards	Database management system software – AlphaFour software; Microsoft Access; Microsoft SQL Server; Oracle software Development environment software – Assembler; Borland Delphi software; C: Microsoft.NET Framework Enterprise resource planning ERP software – Microsoft Dynamics AX; Microsoft Dynamics NAV; Oracle E-Business Suite; Oracle JD Edwards OneWorld Object or component oriented development software- Borland Paradox; C++; Practical extraction and reporting language Perl; Sun Microsystems Java Web platform development software- Adobe Systems Adobe Flex; JavaScript; Microsoft Active Server Pages ASP; Ruby on Rails

Computer Programmers

Tools used in this occupation	Technology used in this occupation
Computer servers Desktop computers Mainframe computers Serial port cards	Compiler and decompiler software- Code generator software; Command interpreters; Threaded code compiler; Xerces2 Java Parser Database environment software – Microsoft SQL Server; mSQL software; MySQL software; Pick software Development environment software – Haskell; kernel; Microsoft Visual Basic; Ruby Object or component oriented development software- C++; Greatis Object Inspector; Oberon; PowerSoft PowerBuilder Program testing software- Debugging software; Low-level debugger software; Source code editor software; Symbolic debugger software Web platform development software- Apache Struts; Hypertext markup language HTML; JavaScript; Microsoft Silverlight

Computer Software Engineers, Applications

Tools used in this occupation	Technology used in this occupation
Computer servers Flash memory storage devices Integrated circuit testers Notebook computers Personal digital assistant (PDA)s or organizers	Database management system software – Computer Associates integrated data management system CA-IDMS; Data manipulation language DML; Microsoft SQL Server; MySQL software Development environment software- American National Standards Institute ANSI C; IBM Rational Rose XDE Developer; Microsoft Visual Basic; XML Path Language XPATH Object or component oriented development software –



	<p>DRAGOON software; Self; Simulation language SIMULA; Smalltalk</p> <p>Program testing software – IBM Rational PurifyPlus; Mercury Interactive LoadRunner; Source code editor software; Usability testing software</p> <p>Web platform development software- Extensible stylesheet language transformations XSLT; Hypertext markup language HTML; Javascript; Microsoft ASP.NET</p>
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Computer Software Engineers, Systems Software

Tools used in this occupation	Technology used in this occupation
<p>Central processing unit (CPU) processors</p> <p>Computer servers</p> <p>Desktop computers</p> <p>Integrated circuit testers</p> <p>Personal digital assistant (PDA)s organizers</p>	<p>Database management system software- Microsoft transact-structural query language T-SQL; MySQL software; Oracle procedural language/structured query language PL/SQL; Sybase SQL Server</p> <p>Development environment software- AWK; Flow-Matic; IBM Rational Rose XDE Developer D93; Microsoft Visual Basic</p> <p>Object or component oriented development software- Document Object model DOM Scripting; Emerald; Simpel API or XML SAX; Sun Microsystems Java</p> <p>Operating system software- Linux; UNIS; VxWorks software; Win CE</p> <p>Program testing software- Defect tracking software; Dynamic analysis software; IBM Rational ClearQuest; Mercury Interactive LoadRunner</p>

Computer Support Specialists

Tools used in this occupation	Technology used in this occupation
<p>Computer tool kits</p> <p>Hard disk arrays</p> <p>Network analyzers</p> <p>Power meters</p> <p>Reflectometers</p>	<p>Backup or archival software – Backup and archival software; Disaster recovery software; Microsoft Volume Shadow Copy Service Symantec LiveState</p> <p>Configuration management software- Automated installation software; Deployment software ; Patch management software</p> <p>Desktop communication software- CrossTec NetOp Remote Control; Remote control software; Stac Software ReachOut; Symantec pcAnywhere</p> <p>Internet directory services software- Active directory software; Domain name systems DNS software; Network directory services software</p> <p>Operating system software- Event log monitor software Microsoft Windows Pre-installation Environment; Operating system monitoring software; Personal computer diagnostics software</p>



Computer System Analysts

Tools used in this occupation	Technology used in this occupation
Desktop computers Mainframe computers Notebook computers Personal digital assistant (PDA)s or organizers	Configuration management software-HyperSpace software; IBM Rational ClearCase; Wise Solutions software; Wise Solutions Wise for Windows Installer Database management system software- Microsoft SQL Server; MySQL software Oracle procedural language/structured query language PL/SQL; Sybase SQL Server Development environment software- C; IBM Rational Rose XDE Developer; Microsoft Visual Basic; Symantec Visual Cafe Object or component oriented development software- C++; Distributed component object model DCOM software; Rapide; Sun Microsystems Java Program testing software- Compatibility testing software; IBM Rational PurifyPlus; Mercury Interactive LoadRunner; Usability testing software Web platform development software- Allaire ColdFusion; Cascading Style Sheets CSS; JavaScript; Microsoft Active Server Pages ASP

Database Administrator

Tools used in this occupation	Technology used in this occupation
Desktop computers Hard disk arrays – Redundant array of independent disk RAID systems Hard disk drives Notebook computers Tape arrays – Tape libraries	Backup or archival software – Acronis Recovery Expert; BMC Catalog Manager; Oracle Data Guard; VERITAS NetBackup Database management system software – Microsoft SQL Server; MySQL software; Quest Central; Sybase Replication Server Development environment software – C; Microsoft Visual Basic; Prolong; Restructured extended executed or REXX Metadata management software – AllFusion Erwin Data Modeler; Data modeling software; IBM Rational Data Architect; Visual; Paradigm DB Visual ARCHITECT Object or component oriented development software – Microsoft Visual Basic.NET; Practical extraction and reporting language Perl; Sun Microsystems Java; Sybase PowerBuilder

Network and Computer Systems Administrator

Tools used in this occupation	Technology used in this occupation
Computer tool kits Interferometers- Optical spectrum analyzers Network analyzers – Asynchronous transfer mode ATM analyzers; Bit error rate BER tester; Synchronous optical network SONET analyzers; T-Birds Power meters – Powerline monitors Protocol analyzers	Administration software – Cisco Systems CiscoWorks; Hewlett-Packard HP Network Node Manager; Network shutdown software, SolarWinds software Configuration management software – Application management software; Automated installation software ; Microsoft Windows Sysprep; Systems and applications migration software Network monitoring software – Dartware, InterMapper; Ethereal; Veritas NerveCenter; ZABBIX software Network security or virtual private network VPN management software – Citrix MetaFrame; intrusion prevention system IPS software; OpenService Open Nerve Center; Security incident handling software Transaction security and virus protection software – Encryption software; Honeypot; Packet filter software; Ping software

Network Systems and Data Communication Analysts

Tools used in this occupation	Technology used in this occupation
Integrated services digital network ISDN testers – integrated service digital network ISDN analyzers Mutimeters – Network multimeters Network analyzers – Asynchronous transfer mode ATM analyzers; Bit error rate BER testers; Network connectivity testers; Wider area network WAN analyzers Power meters – Fiber optic power meters Protocol analyzers	Administration software - Citrix MetaFrame; Lucent VitalSuite; NetIQ software; SolarWinds software Configuration management software – Application management software; Automated installation software; patch and upgrade management software; Software distribution software Network monitoring software – Discrete event simulation software; Ethereal; Ipswitch WhatsUp Gold; Symantec Intruder Alert Network security or virtual private VPN management software – Intrusion prevention system IPS software; Network and system vulnerability assessment software; Risk assessment software; Virtual local area network management software Transaction security and virus protection software- CA eTrust; Encryption software; McAfee VirusScan; Penetration testing software



Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

Tools used in this occupation	Technology used in this occupation
Notebook computers – Laptop computers Personal computers Personal digital assistant(PDA)s or organizers Tablet computer	Customer relationship management CRM software- FrontRange Solutions Goldmine software; NetSuite NetCRM; Sybase iAnywhere Pharma Anywhere; Sybase iAnywhere Sales Anywhere Database user interface and query software- Data entry software; Microsoft Access Electronic mail software – IBM Lotus Notes; Microsoft Exchange; Microsoft Outlook Presentation software- Microsoft Powerpoint Project Management software- Kameleon Software E- Business Suite Special Edition Spreadsheet software – Microsoft Excel

Telecommunications Equipment Installers and Repairers, Except Line Installers

Tools used in this occupation	Technology used in this occupation
Test meters, circuit diagrams, polarity probes Crew Trucks	Switching system components and associated testing equipment Computer printouts, circuit layouts, work orders and diagrams

Telecommunications Line Installers and Repairers

Tools used in this occupation	Technology used in this occupation
Splice cables, hand tools, epoxy and mechanical equipment Terminal boxes, auxiliary equipment and appliances, bucket trucks, poles and ladders	Amplifiers and repeaters



Tier 8 – Occupation Specific Requirements

This tier includes **occupation specific job credentials** such as educational degrees, certifications, licensures, physical training requirements specific to a particular occupation within an industry. The US Department of Education provides a taxonomic scheme of programs of study and descriptions called Classification of Instructional Programs (CIP). The National Crosswalk Service Center linked this data with the list of occupations in the O*NET Directory and created a comprehensive list of instructional programs for each occupation in each industry.

O* NET DIRECTORY

TIER 8 –Occupation Specific Requirements for:

Computer and Information Systems Managers

Computer Programmers

Computer Software Engineers, Applications

Computer Software Engineers, Systems Software

Computer Support Specialists

Computer Systems Analysts

Database Administrators

Network and Computer Systems Administrators

Network Systems and Data Communications Analysts

Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

Telecommunications Equipment Installers and Repairers, Except Line Installers

Telecommunications Line Installers and Repairers

Computer and Information Systems Managers

CIP Code	CIP Title
11.0101	Computer and Information Sciences, General
11.0401	Information Science/Studies
11.0701	Computer Science
11.1001	System Administration/Administrator
52.0205	Operations Management and Supervision
52.1201	Management Information Systems, General
52.1206	Information Resources Management/CIO Training
52.1207	Knowledge Management

Computer Programmers

CIP Code	CIP Title
11.0102	Artificial Intelligence and Robotics
11.0201	Computer Programming/Programmer, General
11.0202	Computer Programming, Specific Applications
11.0203	Computer Programming, Vendor/Product Certification
11.0801	Web Page, Digital/Multimedia & Information Resources Design
11.0803	Computer Graphics
11.1004	Web/Multimedia Management and Webmaster
26.1103	Bioinformatics
51.0709	Medical Office Computer Specialist/Assistant
51.2706	Medical Informatics
52.0208	E-Commerce/Electronic Commerce
52.1201	Management Information Systems, General



Computer Software Engineers, Applications

CIP Code	CIP Title
11.0102	Artificial Intelligence and Robotics
11.0103	Information Technology
11.0701	Computer Science
14.0901	Computer Engineering, General
14.0903	Computer Software Engineering
15.1299	Computer Engineering Technologies/Technicians, Other
26.1103	Bioinformatics
51.2706	Medical Informatics
51.2799	Medical Illustration and Informatics, Other

Computer Software Engineers, Systems Software

CIP Code	CIP Title
11.0102	Artificial Intelligence and Robotics
11.0103	Information Technology
11.0401	Information Science/Studies
11.0701	Computer Science
11.1002	System, Networking, and LAN/WAN Management/Manager
14.0901	Computer Engineering, General
15.1299	Computer Engineering Technologies/Technicians, Other



Computer Support Specialists

CIP Code	CIP Title
01.0106	Agricultural Business Technology
11.0301	Data Processing and Data Processing Technology/Technician
15.1203	Computer Hardware Technology/Technician
15.1204	Computer Software Technology/Technician
30.1601	Accounting and Computer Science
51.0709	Medical Office Computer Specialist/Assistant

Computer Systems Analysts

CIP Code	CIP Title
11.0101	Computer and Information Sciences, General
11.0103	Information Technology
11.0501	Computer Systems Analysis/Analyst
11.1004	Web/Multimedia Management and Webmaster

Database Administrators

CIP Code	CIP Title
11.0101	Computer and Information Sciences, General
11.0501	Computer Systems Analysis/Analyst
11.0802	Data Modeling/Warehousing and Database Administration
11.1003	Computer and Information Systems Security
52.1201	Management Information Systems, General



Network and Computer Systems Administrators

CIP Code	CIP Title
11.0101	Computer and Information Sciences, General
11.0401	Information Science/Studies
11.0501	Computer Systems Analysis/Analyst
11.0901	Computer Systems Networking and Telecommunications
11.1001	System Administration/Administrator
11.1002	System, Networking, and LAN/WAN Management/Manager
11.1003	Computer and Information Systems Security
11.9999	Computer and Information Sciences & Support Services, Other

Network Systems and Data Communications Analysts

CIP Code	CIP Title
11.0101	Computer and Information Sciences, General
11.0103	Information Technology
11.0501	Computer Systems Analysis/Analyst
11.0901	Computer Systems Networking and Telecommunications
11.1002	System, Networking, and LAN/WAN Management/Manager
11.1003	Computer and Information Systems Security

Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

CIP Code	CIP Title
52.1804	Selling Skills and Sales Operations
52.9999	Business, Management, Marketing, & Related Support Services, Other





Telecommunications Equipment Installers and Repairers, including Line Installers *

CIP Code	CIP Title
47.0103	Communications Systems Installation and Repair Technology

*Telecommunications Equipment Installers and Repairers, Except Line Installers and Telecommunications Line Installers and Repairers are required to have the same minimum level of **occupational specific job credentials**.

Tier 9 – Management Competencies


This tier includes competencies that are specific to supervisory and managerial occupations within this industry. These competencies are:

- Manpower Planning
- Delegating
- Managing Work Flow
- Entrepreneurship
- Leadership
- Developing & Monitoring
- Preparing and Managing Budgets
- Team Building
- Developing an Organizational Vision
- Managing Resources



Competency models can serve as a map for education/training providers, employers, job seekers, workforce and economic developers. A sustainable pipeline of skilled workers can be built when all these stakeholders work together in cooperation. Some recommendations for the use of the IT competency Model are:

1. As emphasized continuously by employers, one of the key findings of this study was the shortage of the presence of “soft skills”, especially in the incumbent workforce. It was not sufficient to be technically qualified alone; employers expressed the need for them to possess additional skills as described in the Foundational Competencies tiers of this model. This message needs to be conveyed to all education providers in the state. The Department of Economic Development (DED) can collaborate with partners in Missouri Department of Higher Education (MDHE) to promote educational efforts geared towards preparing students for college and the workplace. This work could be accomplished through :
 - ❖ Creating a cross-walk between the Curriculum Alignment Initiative entry-level competencies and the foundational competencies in Tiers 1& 2
 - ❖ Having MDHE promote the findings of the IT competency model report to postsecondary institutions, for their use in reviewing current curriculum for IT-related degree programs and aligning business driven competencies with entry and exit skills as defined by education/training providers
 - ❖ Present progress on these activities to the P-20 Council by the end of state fiscal year 2010
2. As the IT field contains both occupations that require postsecondary training as well as those that do not, hence soft skills training/development needs to start as early as K-12. The Department of Elementary Secondary Education (DESE) along with the Missouri Center for Career Education can use several of the report’s findings as a useful tool in their role as a change agent for the field of career education in Missouri in the following ways:
 - ❖ Utilize Tiers 1-5 as the basis for developing measurable learner objectives (MLOs) for use by classroom teachers in an occupational area
 - ❖ For programs that are occupationally specific and represented in the targeted sectors, Tier 5 could also be used as a basis for curriculum development
 - ❖ The model could also be used as a resource for new teacher induction programs and other professional development efforts
 - ❖ The results could be integrated into work on programs of study, curriculum development and data driven decision making
3. This report can also assist the IT council (comprising of IT industry top executives) direct creative strategic plans intended for growth within the IT sector by :
 - ❖ Making this report available and easily accessible to more IT employers in the state through identified professional groups and industry associations
4. The competencies derived from the IT competency model serve as a training map for specific IT occupations and could be compared to current training available in public postsecondary institutions to identify “skill gaps” as identified by employers with results tied to regional demand.
 - ❖ A further gap analysis between Missouri employer training needs versus Missouri education/training program offerings could be conducted

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5. Integrate the IT competency model results in the development of career information products for job seekers and both elementary/secondary and postsecondary students. This could be disseminated through :
- ❖ The Public Outreach Partnership (POP), a collaborative workgroup with representatives from DESE, DHE, MERIC, Department of Economic Development Division of Workforce Development (DWD), MCCE and the Missouri Chamber of Commerce. The POP workgroup represents state agencies concerned with education and workforce development that are helping inform and build awareness among the public, particularly students and potential students, of targeted careers, educational and industry trends, and workforce development priorities.
 - ❖ Missouri Connections, a website that helps students (grades 7-16), their parents, guidance counselors, and educators in career exploration and education planning.



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3. MERIC, Occupational Projections –Statewide(2006-2016)
4. MERIC, *Missouri Job Vacancy Survey (JVS)*
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9. Illinois Occupational Skill Standards and Credentialing Council, *Illinois Occupational Skill Standards*
10. Office of Career, Technical & Adult Education, Nevada Department of Education, *Information Technology Skill Standards Grades 9 -14*.
11. Georgia Department of Education, *Georgia Competency Based Curriculum Frameworks, Career & Technical Education, Information Technology*
12. itWORKS.OHIO, *Information Technology Career Field Technical Content Standards with Academic Content Standards in English Language Arts and Mathematics*
13. O*Net - <http://online.onetcenter.org/>
14. Competency Clearing House - <http://www.careeronestop.org/competencymodel/>



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